LIGHTING DATA

EDISON LAMP WORKS
OF GENERAL ELECTRIC COMPANY

GENERAL SALES OFFICES HARRISON, N. J.

The Lighting of Public Buildings

Information compiled by
A. L. POWELL and E. PARKER
Lighting Service Department

INDEX 39 JANUARY, 1922 BULLETIN L. D. 135

SYNOPSIS:

For information regarding MAZDA lamps and lighting questions, refer to the nearest sales office.

To insure receipt of bulletins, notify the Department of Publicity, Edison Lamp Works of General Electric Company, Harrison, N. J., of any change of address.

The Lighting of Public Buildings

Information Compiled by A. L. Powell and Edgar Parker
Lighting Service Department

Introductory

A thoroughly satisfactory building really depends upon the preliminary planning of the lighting simultaneously with the structural elements, and as public buildings in general are elaborate structures with special lighting requirements, the best results are obtained only when these features are carefully considered beforehand. For example, adequate space should be available for lamps and reflectors above skylights where such lighting is employed;

FIG. 1
A Night View of a Well Known Painting Gallery Illuminated by 40-watt MAZDA Lamps in a Continuous Rippled Mirrored Glass Reflector. The lamps are spaced on 12-inch centers and produce an intensity of 6 foot-candles on the paintings, without image reflections in the line of view. The moon renders the skylight luminous

flexible control and a sufficient number of circuits to take care of future demands should be provided for; and convenience outlets at frequent intervals to meet particular conditions are all factors worthy of preliminary consideration.

Our public buildings represent a considerable investment for the education, protection and enjoyment of the people, and, in order that the privileges tendered by these buildings may be utilized and that the interior may provide comfortable conditions for those employed here, it is of the utmost importance that adequate lighting be provided.

Lighting of Art Galleries

Proper lighting of the art gallery is both an important and interesting subject. The buildings themselves represent a large expenditure, are more or less monumental in character and dignity, and consequently require artistic and harmonious lighting. In the second place, priceless collections of paintings and sculpture are exhibited here and these must be well lighted so that the public may view and study them in comfort, And third, in order that these works of art may be presented so that the details will stand out as the artist conceived them, we must not only have ample light, but direction and color values must be carefully considered.

Paintings

The logical arrangement of the paintings is to place those of a dark nature at the top, for, with predominant light from above, the higher intensity will naturally be on the paintings which require it. We see by reflected light and, when this fact is considered, it at once becomes apparent that by this arrangement a more uniform and attractive gallery is the result.

The background, or walls, should be of a neutral tone, non-glossy in character and of low reflecting power, so that reflections from the walls are eliminated and there is consequently nothing to distract the attention from the exhibit. The neutral tone is of special importance as a brilliantly colored background may reflect enough light to modify the color value of the paintings quite materially. For example, a red background was used in the Tate Gallery in England, and its selective reflection distorted the color of some of the finest Turner paintings.

There are two general methods commonly employed in the illumination of galleries—one, where the lighting is accomplished from the sides, and the other, where the direction of light simulates actual daylight conditions and comes from overhead. Whatever system is used, the intensity should be sufficient to illuminate the dullest piece in a collection, and care should be exercised to see that specular reflections from the painted and glass surfaces are minimized. The reader has often had the experience when viewing a collection of being annoyed by a multiplicity of reflections which distract greatly from the interest of the exhibit.

This condition is most frequently encountered where the side system is employed as evident in Fig. 2. Here the paintings are represented as illuminated by lamps in a continuous trough reflector, and the light rays are indicated by the broken lines. The collections are usually viewed from the area between A and B, and eye level is shown by the dotted line. It can be readily seen from

the sketch that any slight divergence of the fixture from the correct position will cause the light rays to be reflected into the area from which the paintings are viewed, causing annoying specular reflection.

Both individual and continuous units are employed for the side lighting system. It is evident that, whatever type is utilized, the principles outlined in the above paragraph should be adhered to and careful design or experimentation is essential before the final installation is made. Even where individual units are employed, it is generally desirable to conceal these from view by a suitable screen or framework of metal or other material.

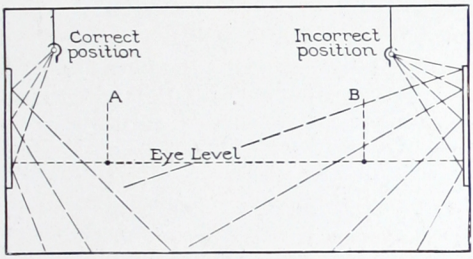

FIG. 2

Section of a Painting Gallery, Showing How an Incorrectly Placed Fixture May Result in Annoying Specular Reflections

Mirrored glass offers certain advantages in the flexibility of control of distribution, but plain or smooth mirrored surfaces should never be employed on account of image reflections. For temporary installations, white paint enamel gives excellent results from the standpoint of reflective properties and diffusion, but for permanent installations is quite out of the question, as it turns brown from the heat of the lamp, blisters and peels, as well as accumulates dust, thus having its reflecting power considerably lowered. The exterior finish of the lighting equipment and supporting mechanism should be neat and harmonious with the room decorations.

The number and size of lamps to employ will depend on the character of the exhibit and should be determined from experiments. For ordinary conditions, from 40 to 60 watts per running foot of wall space will provide an intensity of approximately 6 foot-candles on the picture. A night view of an art gallery with a typical side lighting system is given in Fig. 1. A continuous trough reflector, with rippled glass strips so placed as to give the desired distribution of light, is used.

It is certainly desirable, when the construction of the building permits, to utilize the skylight as a method of illuminating paintings, for not only can a better lighting effect be obtained, but the appearance of the room without fixtures is much more attractive (Fig. 3). Here the lighting installation is placed above the skylight and a uniform intensity of 6 foot-candles is obtained upon the walls.

The room presents a very attractive appearance and the uniform illumination of the glass in the skylight is worthy of

FIG. 3

The Attractiveness of This Painting Gallery, Illuminated from Above the Skylight, is Apparent at a Glance. 60-watt MAZDA lamps in porcelain enameled reflectors are placed on 3-foot centers and suspended 18 inches above the glass skylight. These lamps are supplemented by 40-watt MAZDA lamps, spaced 14 inches in a trough reflector, placed at the edge of the skylight and directed to throw the light toward the walls, thus keeping the horizontal and vertical components of the light more nearly equal

mention. The glass itself is of such a nature that the lamps or overhead construction cannot be discerned from the room below.

In a system of this type, the hanging height of the units above the skylight will depend upon the wattage of the lamps used, and upon the glass in the skylight. The lamps and reflectors should be so arranged that the glass presents a uniform appearance from the room below, and the glass itself should be of such a nature that the lighting source cannot be discerned through the glass.

In the installation pictured in Fig. 3, relatively low wattage lamps were made necessary by the close spacing of the steel girders supporting the skylight. Where the space above the skylight is not

obstructed by girders, higher wattage lamps spaced farther apart and at a greater distance above the glass are advisable.

In some instances angle units can be so suspended as to direct the light on the opposite wall and are generally preferable on account of their higher vertical components to reflectors giving a symmetric distribution of light. Projector units have also been successfully applied to this service, their advantages being accurate control of light distribution and compactness. To avoid spotted appearance of the glass it is sometimes necessary to employ opaque shields to obstruct the direct light. With an installation of this type it is advisable to employ a glass which, while concealing the location of the lamps, does not materially affect the distribution of light by introducing a great amount of diffusion.

Descriptions of various installations employing the schemes outlined above will be noted in the bibliography.

Another factor which requires consideration when the gallery is equipped with a skylight, is the continually changing quality of daylight so that some system or method of modifying the intensity should be provided for. This may be effectively accomplished by installing a system of adjustable louvres between the sub-skylight and the main skylight. The louvres may be of thin metal painted white, or may be of cloth on wooden frames, and in either case they should be controlled either pneumatically or electrically from the room below. Thus, when the sun is in such a direction as to light one wall to a higher intensity than the opposite, the attendant may adjust the louvres until more uniform illumination is obtained.

A much simpler method is to provide a white diffusing curtain between the two skylights which can be drawn across the skylight when the intensity is too high. This system is, of course, less expensive, but is by no means as satisfactory or flexible as the former.

The question of proper color quality of artificial light for an art gallery can be viewed from many angles. All of us know that a distortion of hue results when lights of different spectral characteristics fall on colored objects. (See Bulletin Index 3, "Artificial Daylight for Merchandising and Industry.") This is true even in daylight. One artist, for example, noted that his blues were never as vivid in the finished picture as when he mixed them on his palette under the open sky by the seashore with the bluish skylight as a factor.

At the other extreme, all our common light sources are rich in the red and yellow, making distortion even greater than with variations of natural light. That this is not fully appreciated, is

apparent, for one prominent artist is recorded as saying that the color of artificial light was of no importance as "a work of art is a work of art under any conditions." Physical conditions may be such as materially to modify this viewpoint.

From a theoretical standpoint in displaying a painting, it seems most logical to attempt to reproduce conditions under which it was conceived. A picture painted by daylight obviously transfers the artist's conception best under natural light, while those painted in artificial light should have similar treatment.

In an art gallery, however, we find all types in the same group, and even the position of individual works may be changed from time to time. It is scarcely expedient to be constantly shifting the lighting.

It is probable that the majority of pictures were produced under daylight conditions and the MAZDA Daylight lamp is a suitable light source for the art gallery. It is a compromise between unmodified artificial light and average daylight, sufficiently efficient to warrant its use. When lamps of this character are used, the transition at nightfall is much less noticeable.

There is another phase of the question which is not generally applicable to the large gallery and is possibly open to objections on the part of the true connoisseur, that is, special lighting by tinted lamps of individual pictures. Many paintings appear to better advantage when so lighted. Certain colors or tones may be accentuated or subdued with skillful treatment. Again, each picture may be illuminated by light with a certain predominating direction, coincident with the general direction of light in the picture, thus heightening the contrast. This field presents many varied and interesting problems and, in general, needs specialized study of each individual work. A rather complete discussion is given in one of the references cited.

For mural and ceiling paintings, similar requirements as to uniformity, color and intensity, to those encountered with pictures hanging on the walls are presented.

With decorated ceilings, unless structural details are such as to cause a suspended indirect unit to be in good taste, the side system, i.e., trough or cornice, offers the best solution. Cornice lighting obviously requires very careful design to avoid spotted effects or specular reflections and, since the lighting units are inverted, proper maintenance or cleaning is a very important element. (See Bulletin Index 14, "Maintenance of the Lighting System.")

It is apparent we cannot readily reproduce the equivalent of the top lighting system, although the ceiling in one of the build-

ings at the Panama-Pacific Exposition was illuminated by searchlights below the plate glass floor, and with ingenuity, similar results can be secured in a less expensive and effective manner.

A novel installation of this character is to be observed in Gallery No. 32 at the Metropolitan Museum of Art, New York City. In a room about 20 feet square, are installed a series of twenty-two ceiling paintings by Picturrichio. These panels are from the Plazza Del Magnifico in Sienna, and the attempt was made to show them in a direct reproduction of their original settings. The

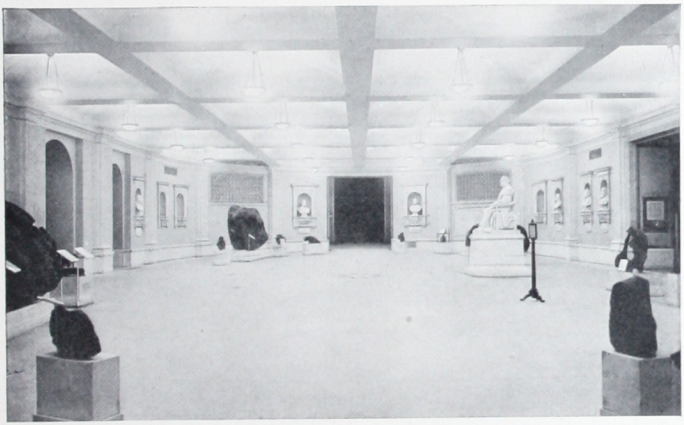

FIG. 4

A Night View of the Foyer of a Museum Showing the Pleasing Effect Obtained by Using Diffusing Bowls. Three 75-watt MAZDA lamps are used at each of the outlets which are on 16-foot centers, giving a uniform intensity of 4.5 foot-candles throughout the foyer

architectural construction of the room prohibited the use of cove or cornice lighting, and ceiling units would obviously be unsuitable.

The lighting equipment was placed outside the six cathedral glass windows, located three on a side on opposite walls. Each is about 4 by 6 feet and three 100-watt MAZDA C lamps without reflectors are symmetrically placed at the rear of the glass. These are supplemented by a row of 25-watt MAZDA lamps on 9-inch centers in a mirrored glass reflector at the bottom of the window. The total power consumption is approximately 4 watts per square foot of floor area.

Natural light enters through exterior windows, and then passes through the art glass panes mentioned above. At night a shade is

drawn between the two windows, which acts as a reflecting and diffusing surface. The resultant light is soft, comfortable and effective. The intensity on the ceiling is about 1 foot-candle.

Statuary

The sculptor may choose the most perfect piece of marble and model it into a sublime work of art, a perfect reproduction of his inspired vision, yet a careless arrangement of the work with reference to predominant light may cause unseemly distortions and a shattering of the expressed ideals.

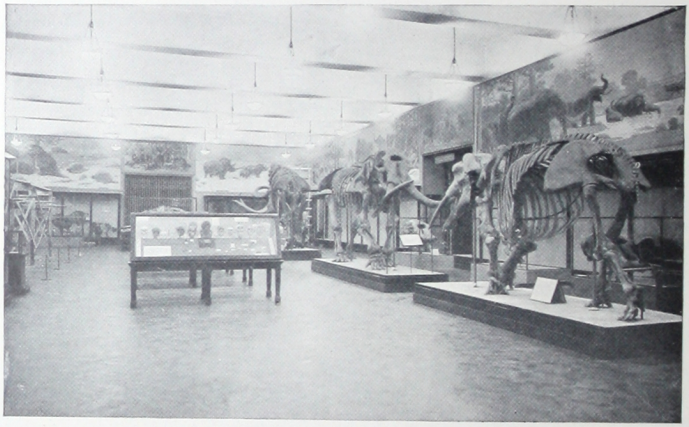

FIG. 5
The Effective Illumination Produced by a Semi-indirect System is Well Shown in This Night View of an Exhibit Room. 300-watt MAZDA lamps in opalescent bowls on 16-foot centers provide an average intensity of 7 foot-candles

The beauty of statuary lies in the relation of high lights and shadows. The desirable density, sharpness and quantity of shadows, depend upon the emotion to be depicted. Tragedy demands sharp contrast and bold shadows, as exemplified in the Laocoon group. On the other hand, a piece of work similar to Aphrodite, portraying soft, subtle modelling, and a face of radiant pleasure, needs a softer light to bring out the effect of the more quiet emotion. Shadows are troublesome in sculpture only when they tend to produce false impressions.

Under artificial light, the degree of shadows produced depends upon the type of unit used. If a direct lighting system is employed,

the sharpest of shadows are produced with little diffusion, except that reflected from surrounding surfaces, such as walls and floors. With a totally indirect system, of course, a minimum of shadows is obtained and this lighting is scarcely of service. With semi-indirect units, however, we have a particularly fortunate condition. The proportion of direct to diffuse or reflected light is dependent on the density of the glass of the bowl or, with a given density of glass, these factors can be varied by tinting and toning the ceiling, increasing its absorption. Enclosing or semi-enclosing diffusing units having similar properties to semi-indirect units are also useful in producing a suitable combination of direct and diffuse light.

FIG. 6
A View of a Northern Florida Group, Depending Entirely upon the Artificial Illumination for the Lighting Effect

A systematic arrangement of either of these two latter types of units, providing an intensity of from 4 to 6 foot-candles, gives good results. Since a greater amount of direct light is usually produced immediately beneath the outlet, it is quite logical to locate in such positions objects requiring well defined shadows and those of "softer" lines in the more diffusely lighted areas.

Thus, artificial light, on account of the possibility of readily changing the intensity, color and direction, is one of our best mediums of artistic treatment. Crude, stagey effects should be avoided and one must realize that, while lighting cannot make art, it can certainly mar it.

Lighting of Museums

Our museums contain priceless collections of natural, scientific, and literary curiosities, conveniently exhibited where the public may view and study them at leisure. It is important that the specimens be arranged and displayed to their best advantage, and this cannot be accomplished unless the exhibit is properly illuminated to facilitate careful study.

There must obviously be good general lighting, special lighting of a high intensity for small objects in show cases, and more or less of stage lighting effects where a group is presented in its natural setting.

Glaring light sources and reflected images must be avoided, for there is no one factor which tends to reduce the effectiveness of a museum more than annoying reflections in the glass surfaces of the cases. A well diffused, general lighting is required, of an intensity of 6 to 8 foot-candles, so arranged that it will not cause objectionable shadows on the exhibits. The indirect systems or diffusing direct lighting units of neat simple lines meet these demands. The fixture itself should be dignified and in conformity with the architecture of the building. In the foyer and similar places, massive ornamental standards or multiple unit fixtures are frequently necessary for their decorative value.

Fig. 5 shows a lighting installation carrying out the principles outlined above. Relatively high wattage MAZDA C lamps are employed in neat semi-indirect bowls of medium density. The diffuse light makes the room comfortable, illuminates the exhibits effectively, shows up the mural paintings to good advantage, and eliminates annoying reflections from the table and wall cases.

The lighting of exhibit cases is obviously an important feature. In general, they may be divided into two distinct groups—those constructed entirely of glass and readily illuminated by the general system, and those which have an opaque top, or are of such a nature as to require local illumination. The principles applicable to store window lighting, as treated in Bulletin Index 31, are effective here. The wall cases usually have a cornice at the top behind which lighting equipment may be readily installed in an inconspicuous manner. As most of the cases are air-tight in order that they may be dustproof, it is important that low wattage lamps be employed to prevent excessive heating. Small mirrored glass or metal individual reflectors or continuous trough equipment can be utilized. The type of distribution given by the selected reflector will naturally depend on the dimensions of the case.

The most interesting phase of museum lighting is that of providing special effects for cases or alcoves containing objects in their natural surroundings. The principles of stage lighting have been applied to the show window with excellent results. They are especially applicable here. The method of handling individual exhibits will depend on the construction of the case and the ingenuity of the designer. Figs. 6 and 7 present two typical examples. In the former, a North Florida group, showing birds and reptiles in characteristic attitudes, the top of the case is of diffusing glass. Above this is located a row of 40-watt MAZDA

FIG. 7

The Night View of an Alcove Containing a Hopi Indian Group Shows the Effectiveness of Skillfully Applied Artificial Light. The principles of stage lighting are directly applicable to such displays

lamps in bowl type reflectors along the front edge of the case. In another position is placed a group of 100-watt lamps in concentrating reflectors, directed so as to give the appearance of sunlight streaming through the foliage.

In Fig. 7 a group of Hopi Indians are busily engaged in their daily household tasks. The old man in the background casts a dense shadow behind him. The foreground is in comparative darkness, while the village itself is brilliant with the noonday sun. Twenty-five-watt MAZDA lamps in bowl shaped reflectors are carefully concealed from view and illuminate the general scene. A 250-watt concentrated filament lamp in a small lens spot lamp directs the

beam of light as indicated by the shadow effects. Color and direction of light are again of service in conjunction with experimentation.

The laboratory and workshops of the museums, where figures of the groups are cast or modelled specimens mounted, magnified copies of objects made in glass and wax, and models of all sorts repaired, offer no distinct problem from those of the ordinary industrial plant, with similar demands on vision. A high intensity of general illumination with efficient direct lighting units, such as RLM Standard dome reflectors and bowl enameled MAZDA C lamps, will permit accurate work amid pleasing surroundings. Convenience outlets to which suitably shielded local lamps can be attached are necessary along the benches in order that the very high intensity necessary, when working on minute objects, can be available.

Lighting of Libraries

The use of a library reflects to a greater or less degree the intellectual and artistic standing of the community, and there is, perhaps, no better way to invite patronage than by making the interior attractive and comfortable. Even though the building is beautifully designed and well provided with books, unless its lighting is suitable and adequate, it is not a thoroughly effective institution. The primary function of the lighting installation is to enable printed matter to be read with ease, but in addition it offers an opportunity for accentuating the architectural design and beauty of the building.

Libraries may be divided into two quite distinct classes—one, the monumental building of the large city where the rooms are spacious, ceilings high, corridors handsomely finished in marble, and where the element of decoration plays a large part. Reading rooms in this class of building are generally separate from the stack room. The other, the branch, public school or town library, unpretentious in nature, where the books are stored in cases around the room. Here the decorative feature is secondary and utility of light plays a more important part.

It is quite common practice to install decorative fixtures in the high ceiling reading room of the first class of buildings. These supply a moderate intensity of general illumination, necessary for supervision and to prevent severe contrasts of brightness, but are seldom designed to supply enough light for continued reading. All too frequently, the decorative value is apparently the only element of design given sufficient weight, and examples are well known of glaring and hence ineffective installations. Unshaded lamps are studded in huge clusters, sometimes unfortunately in the field of view. It is quite out of the question to lay down specific rules on

this phase of lighting, for individual taste varies, and earnest co-operation between the architect, fixture specialist and illuminating engineer is advisable.

The lighting in the library shown in Fig. 8 is an excellent example of the principle of co-operation just mentioned. Indirect illumination, as used in this room, offers certain advantages in eliminating reflections from polished table tops and providing good illumination on vertical surfaces, such as shelves and files, without the use of special lamps. The absence of hanging ceiling fixtures makes this particular installation especially effective and gives the

FIG. 8

Night View of the Library at the University of Michigan. General illumination furnished by 100-watt MAZDA C lamps in mirrored glass reflectors on 4-foot centers on the tops of the book cases. The light cream ceiling reflects well and the result is diffused, shadowless illumination

room an appearance of spaciousness. With units placed in the positions indicated, they are easily accessible, making maintenance a simple matter, and, with cleanliness, the initial efficiency of the installation can be retained.

In addition to the general illumination of from 2 to 4 foot-candles, local lighting should be supplied on the tables. These lamps should be very carefully chosen, so placed, and of such a character that direct or reflected glare is minimized. Many standard types in wide use are most inappropriate and productive of eye fatigue. A number of special designs are available, which carry

out the principles outlined in one of the articles mentioned in the bibliography. An even distribution of light on the table top, of an intensity of 6 to 8 foot-candles, is suitable, although higher intensities are sometimes necessary where faded manuscripts or books with very fine type are likely to be used.

In many respects proper table lighting is an economy, producing a high intensity over the working area while a lower intensity is sufficient in the rest of the room. This is particularly important in the library at night where but few readers are likely to be present. Each reader will then control his own local illumination; the attention will be concentrated upon the work, and with such an installation as pictured in Fig. 9, the body of the lamp in effect isolates readers on opposite sides of the table.

As mentioned, in the reading room of the second class of buildings are located the book stacks, and general lighting with the indirect systems is the most logical method of meeting the requirements. With the present-day high efficiency lamps, it is perfectly advisable to supply from 6 to 8 foot-candles throughout the room. For data on the size of lamp, spacing, etc., see Bulletin Index 13, "Calculation of the Lighting Installation." This eliminates the necessity and bother of local or table lights. The diffuse character of the illumination thus produced gives excellent lighting on the vertical surfaces of the stacks.

The catalog room of the city library is generally lighted by massive ornamental fixtures and the remarks relative to the reading room apply to this part of the building. Simple brackets, attached to the filing cabinets, carrying relatively low wattage lamps in deep bowl or angle reflectors increase the intensity of illumination in that region to 6 or 8 foot-candles.

The periodical rooms and special reading rooms are similar in nature to the small library, and the type of lighting suggested for use there fits these conditions.

In the stack room, the titles and numbers on the books must be readily discernible, and an average intensity of from 2 to 4 foot-candles is desirable. Twenty-five or 50-watt MAZDA lamps with deep bowl opalescent glass reflectors, attached to a line of overhead conduit over the aisles, on 6 to 10 foot centers, will fulfill the demand. Where the aisles are of considerable length, three-way switches at both ends are an economy in enabling the attendant to switch on the required lights and to extinguish them after the desired book has been obtained.

In the entrance and corridors, as with the museum, the decorative element is predominant, and any of the systems of lighting

can be applied here, provided an intensity of from 1 to 2 foot-candles for safe ingress and egress is available. Enclosing units offer certain advantages from a standpoint of diffusion and can be well supplemented by wall brackets of ornamental design.

The principles of industrial lighting apply to the bindery, and this is a far more important element of library operation than most of us realize. The huge circulation of our large libraries entails a great deal of repair work and rebinding. As with any factory, high

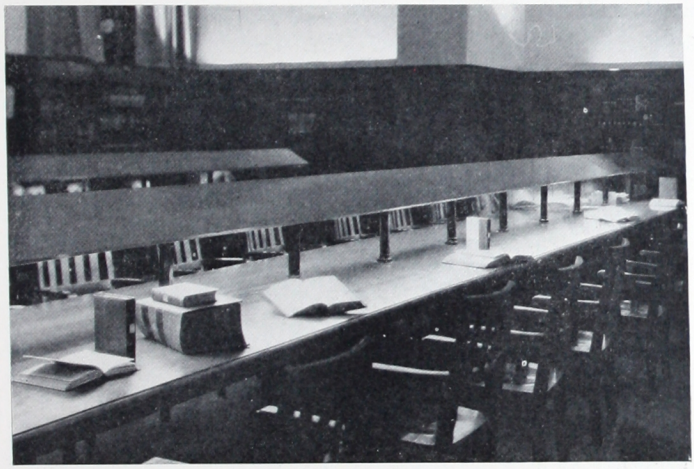

FIG. 9

Night View of One of the Reading Tables in the Library Shown in Fig. 8. A special fixture in the form of a continuous trough eliminates glare both direct and reflected, distributes the light uniformly and presents a pleasing appearance. The interior is finished in white and acts by diffuse reflection while the exterior harmonizes with the furniture

level well diffused light will be productive of increased output. See Bulletin Index 67, "The Lighting of Printing Plants."

Lighting of Municipal, County and State Buildings

The larger portion of these structures is devoted to private and clerical offices, the illumination of which has been thoroughly discussed in Bulletin Index 35. Entrances, corridors, and reception rooms are similar in demand to those in the museum, and, where inscriptions and mural paintings prevail, care should be taken to see that the type of unit chosen for lighting permits these to be seen in a clear and effective manner.

Committee and jury rooms have the same general requirements as the office, although a lower intensity (3 to 5 foot-candles) is sufficient. In many instances, however, these rooms are finished in dark wood, which makes the lighting problem considerably more complex. Bracket units with unshielded lamps must be avoided, and diffusing enclosing globes, well out of the angle of view, offer probably the best solution. The character and design of the supporting fixture will depend on the elaborateness of the decoration. The beautifully finished room pictured in Fig. 10 would be much more pleasant if the wall brackets were omitted and the general lighting fixtures placed closer to the ceiling.

FIG. 10
A Committee Room Handsomely Finished in Dark Woodwork with its Beauty Reduced by Sharp Contrasts in Brightness Due to Improperly Used Wall Brackets

Figuratively speaking, light and justice are always associated, and yet an investigation of the lighting in our court and assembly rooms shows them to be, in many instances, dark and dingy. When necessity arises for proving physical facts by visible evidence, it is often difficult to observe the details of the exhibit. During a court trial, it is certainly desirable that the judge and jury should see the witness with the utmost distinctness as testimony is being given, and it is evident that proper lighting is essential.

Many of our court rooms are still illuminated by open burner gas jets, or by old gas fixtures which have been slightly altered to accommodate such electric lamps as would go inside the globe,

without any forethought from the standpoint of intensity, distribution or diffusion.

The general lighting requirements are similar to those of an auditorium, and lighting units even though of a decorative nature, should be suspended well out of the line of vision. Wall brackets at the front of the room are especially objectionable, as they are continuously in the field of view, and one's attention is naturally directed toward the judge and witness. An example of such an installation is to be seen in Fig. 11.

While stage effects are not in especially good taste, there is no reason why advantage should not be taken of some of the principles

FIG. 11
This Court Room Would Have Been Much More Comfortable if the Bracket Fixtures at the Front and Sides Had Been Eliminated and the Pendant Units Raised Several Feet

utilized so effectively on the stage. If the director desires to focus the attention of the audience on a particular part of the scene or on one actor, he illuminates this area to a higher intensity by the use of a spot lamp of some sort. If the construction of the building is such as to permit a suspension type spot lamp to be concealed from view, it would seem fairly logical to direct the light from this on the witness stand. A sharply defined spot would not be desirable, but on the other hand, one which shaded off gradually would produce the desired effect without being noticed by the casual observer.

There are many cases which come to trial where the verdict depends on a close examination of the evidence, as in the case of

forgery, or an erasure in a document. Much time may be lost if the case has to be adjourned to an adequately lighted room in order to view the exhibit. If convenience outlets are provided to which local lamps giving a high intensity of illumination can be attached, this work can be carried on without loss of time. The accurate type of color identification unit, providing illumination of a high intensity over a small area of a true daylight value, should be useful. The paper by Mr. A. S. Osborn, "The Relation of Light to the Proof of Documents," noted in the bibliography, points out the importance of this question and the desirability of employing some such scheme as suggested.

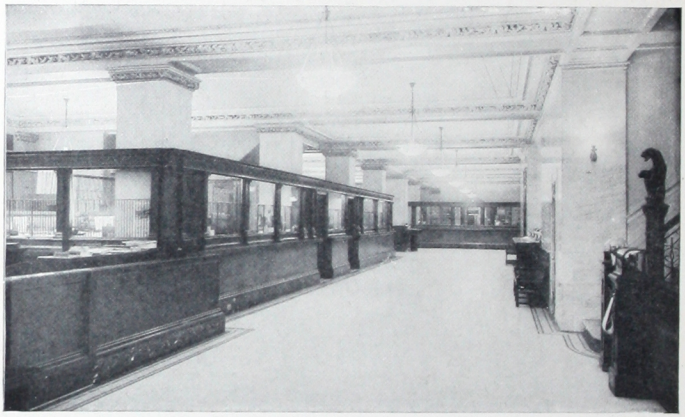

FIG. 12
A Well Lighted Bank Using 300-watt MAZDA Lamps in Semi-indirect Bowls on Centers 18 by 32 feet. The fixtures are simple yet dignified and provide a uniform intensity of 5 foot-candles throughout the main banking space

Lighting of Banks

The lighting system in the bank should be such as to impress the patrons with the dignity of the institution, and yet eliminate any idea that the building is simply a cold storage place for currency, by making the interior comfortable and inviting. A high intensity of illumination will eliminate eye fatigue and thus prevent opportunities for errors, and will increase the speed of the clerical force. It is an asset in advertising the bank, and many deem it advisable to leave the lights burning at night for this purpose, as well as for its protective value.

With the high efficiency of the present-day illuminants the old form of local or drop lighting is gradually being eliminated, and the multiplicity of unsightly cords and tin shades, which formerly occupied the space behind the cages, is becoming a thing of the past. The main banking space should be equipped with general lighting of an intensity of from 4 to 6 foot-candles. Almost any form of fixture which harmonizes with the architectural features might be used, providing it fulfills the general requirements as to distribution and diffusion. If the general lighting is not sufficient, patrons' desks should be equipped with local units producing an intensity of from 8 to 10 foot-candles. The general type of these

FIG. 13

A Night View Showing a Typical Cage Grill Fixture Employing 25-watt MAZDA Lamps Spaced about 14 Inches Apart. The continuous housing conforms with the architectural features of the bank and the well diffused light on the counters facilitates the clerical work

units should be similar to those recommended for reading in the library, and they should be so located as to prevent direct and reflected glare. The exterior of the fixture obviously should harmonize with the other metal work.

A pleasing, yet simple and inexpensive installation of semi-indirect units is pictured in Fig. 12. With a system such as this, larger lamps can be installed in the units over the working portions to provide the higher intensity needed here for bookkeeping.

The general lighting system is often supplemented by cage grill fixtures to raise the intensity at the various wickets to a value of approximately 10 foot-candles. The distribution of light

should be such as to prevent glares and a diffusing glass plate over the opening used to prevent annoying reflections of lamp filaments.

The vaults are used primarily for the storage of valuable documents, and little actual work is carried on here. A lower intensity (3 to 4 foot-candles) suffices. In most instances it is inadvisable to pierce the armor plate of the safe to furnish electric current for lighting purposes. A convenient arrangement to overcome this difficulty is to locate one receptacle outside of the vault connected to the power supply, and another inside of the vault feeding the lighting circuit. When the steel door is opened, a flexible cable with a plug at each end connects the two receptacles. A circuit breaker installed on the line is sometimes used as an economy, for occasionally, through oversight, the steel door is accidentally closed on the cable, thus short circuiting the line. In the vault itself, with its low ceiling, diffusing bulb, small wattage lamps, without reflectors, are satisfactory in close ceiling type receptacles.

Bibliography

"Lighting of the Cleveland Art Loan Exhibition," *Electrical World*, December 27, 1913.

"The Illumination of Art," M. Luckiesh, *General Electric Review*, March, 1914.

"The Lighting of Paintings," M. Luckiesh, *Lighting Journal*, April, 1914.

"The Lighting of Picture Galleries and Art Studios," *The Illuminating Engineer* (London), March and April, 1914.

"Nitrogen-filled Lamps in the Boston Art Museum," *Electrical World*, August 28, 1915.

"Lighting a Small Art Gallery with Gas-filled Lamps," A. L. Abbott, *Electrical World*, March 25, 1916.

"Lighting of an Art Gallery with 'Daylight' Lamps," *Electrical World*, October 28, 1916.

"Lighting of the Cleveland Art Museum," Transactions, Illuminating Engineering Society, Vol. XI, p. 1014.

"The Lighting of Rooms Through Translucent Glass Ceilings," E. J. Edwards, Transactions, Illuminating Engineering Society, Vol. IX, p. 1011.

"Lighting of Foyer of Museum of Natural History," *Electrical World*, April 5, 1913.

"Lighting of the Academy of Science Museum in San Francisco," *Journal of Electricity*, March 1, 1918.

"The New York Public Library," *Electrical World*, December 2, 1911.

"Illumination of St. Louis Public Library," *Electrical World*, July 13, 1912.

"Electricity in the Harper Memorial Library (Chicago)," *Electrical World*, September 21, 1912.

"The Artificial Lighting of Libraries," *Illuminating Engineer* (London), July, 1913.

"Indirect Lighting in School Room Library," Herman Plaut, *Lighting Journal*, March, 1913.

"The Library Lamp," M. Luckiesh, *Lighting Journal*, December, 1915.

"Library Illumination (Milwaukee Public Library)," F. A. Vaughn, *Electrical World*, June 14, 1913.

"The Lighting of Schools, Libraries and Auditoriums," F. A. Vaughn, *University of Pennsylvania Lectures*, Illuminating Engineering Society, p. 307.

"The Lighting of the Widener Memorial Library," *Electrical Review*, August 21, 1915.

"The Relation of Light to the Proof of Documents," A. S. Osborn, Transactions, Illuminating Engineering Society, Vol. IX, p. 498.

"Indirect Lighting of a Banking Room from the Cage Grill," *Electrical World*, September 28, 1912.

"When Architect and Engineer Co-operate," S. G. Hibben, *Lighting Journal*, March, 1913.

"Electric Wiring and Illumination of the Continental and Commercial Bank of Chicago," *Electrical World*, July 26, 1913.

"Indirect Lighting Chicago Bank Interior," *Electrical World*, October 25, 1913.

"Concealed Lighting Fixtures in the Swedish-American Bank in Chicago," C. M. Bunn, *Lighting Journal*, February, 1914.

"Modern Lighting of a Bank by Reconstruction of Old Fixtures," Walter R. Moulton, *Lighting Journal*, May, 1916.

"New Method of Lighting Bank Cages," *Electrical Review*, February 24, 1917.

LIGHTING DATA BULLETINS ISSUED TO DATE

Index No.	L.D. (Serial) No.	
1	114	Edison MAZDA Lamps—Theory and Characteristics.
2	107	The Edison MAZDA Lamp for Motion Picture Projection
3	104	Artificial Daylight for Merchandising and Industry
4	105	110- vs. 220-volt Circuits from the Standpoint of Lighting Service
5	116	The Edison MAZDA Lamp for Stereopticon Service
6	113	Edison Miniature MAZDA Lamps Standard versus—Special
7	118	The Incandescent Lamp—Its History
8	119	The Manufacture of the Edison MAZDA Lamp
13	117	Calculation of the Lighting Installation
14	101	Maintenance of the Lighting System
15	102	Effect of Color of Walls and Ceilings on Resultant Illumination
16	130	The Eye as Affected by Illumination
17	106	Illumination and Production
18	112	Light and Safety
20	122	Commercial Photometry
22	123	Reflectors for Incandescent Lamps
31	103	The Lighting of Show Windows and Show Cases
32	132	The Lighting of Large Drygoods and Department Stores
35	108	The Lighting of Office Buildings and Drafting Rooms
36	109	Lighting of Schools
39	135	The Lighting of Public Buildings
43	121	Medical Lighting, Including Hospital and Dental Offices
44	115	The Lighting of Armories and Gymnasiums
45	129	Lighting for Indoor Recreations
62	134	The Lighting of Metal Working Plants
64	133	Lighting of the Clothing Industry
65	124	The Lighting of Shoe Factories
67	125	The Lighting of Printing Plants
68	110	The Lighting of Textile Mills
69	111	The Lighting of Piers and Warehouses
70	120	The Lighting of Coal Mines
71	128	Railway System Lighting—Buildings and Yards
92	132	The Lighting of Signs and Billboards
93	126	Lighting for Outdoor Sports
98	127	Ship Lighting